

I claim

1. Device for reducing the sound emission from internal combustion engines (1) in an exhaust line (2), which carries an exhaust gas flow (3), having:

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- (a) at least one first sound transducer (13) for converting sound waves (30) into first signals (31), which are a measure of the frequency, amplitude and phase of the sound waves (30),

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- (b) an electronic control unit (14) for converting the first signals (31) into second signals (32) and

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- (c) at least one second sound transducer (15), which is arranged centrally in the exhaust gas flow (3), for converting the second signals (32) into compensating sound waves (33), which have a frequency, amplitude and phase, such that the sound waves (30) and the compensating sound waves (33) at least partially cancel one another out.

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2. Device according to Claim 1, in which the second sound transducer (15) is arranged in the direction of the exhaust gas flow (3), so that the compensating sound waves (33) are emitted in the direction of flow of the exhaust gas flow (3).

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3. Device according to Claim 2, in which the second sound transducer (15) is shielded against the exhaust gas flow (3) by a streamlined casing (16).

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4. Device according to Claim 1, in which the first sound transducer (13) is arranged centrally in the exhaust gas flow (3).
5. Device according to Claim 1, in which the first sound transducer (13) is arranged in the second sound transducer (15).

6. Device according to Claim 1, which contains a catalytic converter (5) having an inlet (6) and an outlet (7) for the exhaust gas flow (3).

5 7. Device according to Claim 6, in which the catalytic converter (5) is designed and arranged in such a way that a largely homogeneous sound field is produced in the space (9) downstream of the catalytic converter (5), in which field the sound waves (30) are propagated essentially in the direction of the longitudinal axis of the exhaust line (2).

10 8. Device according to Claim 1, which furthermore has a pipe silencer, which encloses a space (9), in which at least the second sound transducer (15) is arranged.

15 9. Device according to Claim 1, furthermore having a cooling device for cooling the first sound transducer (13) and/or the second sound transducer (15).

10. Device according to Claim 1, furthermore having a comparator unit (23) for comparing the first signals (31) from the first sound transducer (13) with reference signals.

20 11. Device according to Claim 10, furthermore having an output unit for emitting a warning signal at the occurrence of a predetermined deviation of the first signals (31) coming from the first sound transducer (13) from the reference signals.

25 12. Device according to Claim 10, furthermore having a service monitoring unit for calculating and displaying when the internal combustion engine (1) is next due for servicing on the basis of the time response of the first signals (31) coming from the first sound transducer (13) compared to the reference signals.

30 13. Method for reduction of the sound emissions from internal combustion engines (1) in an exhaust line (2) carrying an exhaust gas flow (3), the method having the following stages:

(a) conversion of sound waves (30) into first signals (31) in at least one first sound transducer (13), the signals (31) being a measure of the frequency, the amplitude and the phase of the sound waves (30),

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(b) conversion of the first signals (31) into second signals (32) in an electronic control unit (14), and

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(c) conversion of the second signals (32) into compensating sound waves (33) in at least one second sound transducer (15), the compensating sound waves (33) having a frequency, an amplitude and phase such that the sound waves (30) and the compensating sound waves (33) at least partially cancel one another out, and the second sound transducer (15) emitting the compensating sound waves (33) centrally in the exhaust gas flow (3).

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14. Method according to Claim 13, having a further processing stage, in which the first signals (31) from the first sound transducer (13) are compared with reference signals in a comparator unit (23).

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15. Method according to Claim 13, in which a warning signal is emitted by means of an output unit at the occurrence of at least one predetermined deviation of the first signal (31) coming from the first sound transducer (13) from reference signals.

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16. Method according to Claim 13, in which a service monitoring unit calculates and displays the date when the internal combustion engine (1) is next due for servicing on the basis of the time response of the first signals (31) from the first sound transducer (13) compared to reference signals.

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17. Device for reducing the sound emissions from internal combustion engines (1) in an exhaust line (2), which carries an exhaust gas flow (3), having:

(a) at least one first sound transducer (13) for converting sound waves (30) into first signals (31), which are a measure of the frequency, amplitude and phase of the sound waves (30),

5 (b) an electronic control unit (14) for converting the first signals (31) into second signals (32) and

10 (c) at least one second sound transducer (15), which is arranged centrally in the exhaust gas flow (3), for converting the second signals (32) into compensating sound waves (33), which have a frequency, amplitude and phase, such that the sound waves (30) and the compensating sound waves (33) at least partially cancel one another out.

15 (d) the second sound transducer (15) being shielded against the exhaust gas flow (3) by a streamlined cover, and

20 (e) being cooled by cooling air, the cooling air flowing past the sound transducer (15) out into the exhaust line (2) in the direction of the exhaust gas flow (3), thereby at the same time preventing the occurrence of exhaust gas backflow turbulence.

25 18. Device according to Claim 17, the device containing a catalytic converter (5) having an inlet (6) and an outlet (7) for the exhaust gas flow (3), which is designed and arranged in such a way that a largely homogeneous sound field is produced in the space (9) downstream of the catalytic converter (5), in which field the sound waves (30) are propagated essentially in the direction of the longitudinal axis of the exhaust line (2).

30 19. Device according to Claim 17, the device having a device for diagnosing the condition and the running of the internal combustion engine (1).

20. Method for reduction of the sound emissions from internal combustion engines (1) in an exhaust line (2) carrying an exhaust gas flow (3), the method having the following stages:

5 (a) conversion of sound waves (30) into first signals (31) in at least one first sound transducer (13), the signals (31) being a measure of the frequency, the amplitude and the phase of the sound waves (30),

10 (b) conversion of the first signals (31) into second signals (32) in an electronic control unit (14),

15 (c) conversion of the second signals (32) into compensating sound waves (33) in at least one second sound transducer (15), the compensating sound waves (33) having a frequency, an amplitude and phase such that the sound waves (30) and the compensating sound waves (33) at least partially cancel one another out, and the second sound transducer (15) emitting the compensating sound waves (33) centrally in the exhaust gas flow (3),

20 (d) shielding of the second sound transducer (15) against the exhaust gas flow (3) by means of a streamlined cover, and

25 (e) cooling of the second sound transducer (15) by means of cooling air, the cooling air flowing past the sound transducer (15) out into the exhaust line (2) in the direction of the exhaust gas flow (3) and thereby at the same time preventing the occurrence of exhaust gas backflow turbulence

30 21. Method according to Claim 20, having a further processing stage, in which by means of a catalytic converter (5), correspondingly designed and arranged, a largely homogeneous sound field is produced in the space (9) downstream of the catalytic converter (5), in which field the sound waves (30) are propagated essentially in the direction of the longitudinal axis of the exhaust line (2).

22. Method according to Claim 20, having a further processing stage, in which the condition and running of the internal combustion engine is diagnosed by means of a device.

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23. A device configured to reduce sound emission from an internal combustion engine in an exhaust line which carries an exhaust gas flow, comprising:

10 at least one first sound transducer configured to convert sound waves into first signals, wherein the first signals are a measure of a frequency, amplitude and phase of the sound waves;

15 an electronic control unit configured to convert the first signals into second signals; and

20 at least one second sound transducer centrally arranged in the exhaust gas flow and configured to convert the second signals into compensating sound waves; wherein the sound waves and the compensating sound waves at least partially cancel one another out.

24. The device according to Claim 23, wherein the at least one second sound transducer is further arranged in a direction of the exhaust gas flow so that the compensating sound waves are emitted in the direction of the exhaust gas flow.

25 25. The device according to Claim 24, further comprising a streamlined casing configured to shield the at least one second sound transducer from the exhaust gas flow.

30 26. The device according to claim 23, wherein the at least one first sound transducer is centrally arranged in the exhaust gas flow.

27. The device according to claim 23, wherein the at least one first sound transducer is arranged within the at least one second sound transducer.

5 28. The device according to claim 23, further comprising a catalytic converter comprising an inlet and an outlet for the exhaust gas flow.

10 29. The device according to claim 28, wherein a largely homogeneous sound field is produced in a space downstream of the catalytic converter, wherein the sound waves are propagated essentially in a direction of a longitudinal axis of the exhaust line in the largely homogeneous sound field.

30. The device according to claim 23, further comprising a pipe silencer configured to enclose a space in which the at least one second sound transducer is arranged.

15 31. The device according to claim 23, further comprising a cooling device configured to cool one or more of: the at least one first sound transducer and the at least one second sound transducer.

20 32. The device according to claim 23, further comprising a comparator unit configured to compare the first signals from the at least one first sound transducer with reference signals.

25 33. The device according to claim 32, further comprising an output unit configured to emit a warning signal if a predetermined deviation of the first signals from the reference signals occurs.

30 34. The device according to claim 32, further comprising a service monitoring unit configured to calculate and display when the internal combustion engine is next due for servicing based on a time response of the first signals compared to the reference signals.

35. A method for reducing sound emissions from an internal combustion engine in an exhaust line carrying an exhaust gas flow, the method comprising:

5 converting sound waves into first signals using at least one first sound transducer, wherein the first signals are a measure of a frequency, amplitude and phase of the sound waves;

 converting the first signals into second signals using an electronic control unit;

10 converting the second signals into compensating sound waves using at least one second sound transducer, wherein the at least one second sound transducer is centrally arranged in the exhaust gas flow; and

15 emitting the compensating sound waves using the at least one second sound transducer; wherein the compensating sound waves and the sound waves at least partially cancel each other out.

20 36. The method according to claim 35, further comprising comparing the first signals to reference signals.

 37. The method according to claim 35, further comprising emitting a warning signal at an occurrence of at least one predetermined deviation of the first signal from reference signals.

25 38. The method according to Claim 35, further comprising calculating and displaying a date when the internal combustion engine is next due for servicing based on a time response of the first signals compared to reference signals.

30 39. A device configured to reduce sound emissions from an internal combustion engine in an exhaust line that carries an exhaust gas flow, comprising:

at least one first sound transducer configured to convert sound waves into first signals, wherein the first signals are a measure of a frequency, amplitude and phase of the sound waves;

5 an electronic control unit configured to convert the first signals into second signals;

10 at least one second sound transducer centrally arranged in the exhaust gas flow and configured to convert the second signals into compensating sound waves wherein the sound waves and the compensating sound waves at least partially cancel one another out;

15 a streamlined cover configured to shield the at least one second sound transducer from the exhaust gas flow; and

 openings configured to allow cooling air to flow past the at least one sound transducer and out into the exhaust line in a direction of the exhaust gas flow.

20 40. The device according to claim 39, further comprising a catalytic converter comprising an inlet and an outlet for the exhaust gas flow, wherein a largely homogeneous sound field is produced in a space downstream of the catalytic converter, wherein the sound waves are propagated essentially in a direction of a longitudinal axis of the exhaust line in the largely homogeneous sound field.

25 41. The device according to claim 39, further comprising a diagnostic device configured to diagnose a condition and an operation of the internal combustion engine.

30 42. A method for reducing sound emissions from an internal combustion engine in an exhaust line carrying an exhaust gas flow, the method comprising:

converting sound waves into first signals using at least one first sound transducer, wherein the signals are a measure of a frequency, amplitude and phase of the sound waves;

5 converting the first signals into second signals using an electronic control unit;

converting the second signals into compensating sound waves using at least one second sound transducer, wherein the at least one second transducer is centrally arranged if the exhaust gas flow, wherein the sound waves and the compensating sound waves at least partially cancel one another out;

emitting the compensating sound waves using the at least one second sound transducer;

15 shielding the at least one second sound transducer against the exhaust gas flow; and

cooling the at least one second sound transducer using cooling air; wherein the cooling air flows past the sound transducer and out into the exhaust line in a direction of the exhaust gas flow.

20 43. The method according to claim 42, further comprising producing a largely homogeneous sound field in a space downstream of a catalytic converter in which the sound waves are propagated essentially in a direction of a longitudinal axis of the exhaust line.

25 44. The method according to claim 42, further comprising diagnosing a condition and operation of the internal combustion engine.

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